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This publication contains information regarding new developments of interest to agriculture based on laboratory and field investigations by the Du Pont Company. It also contains published reports of investigators at agricultural experiment stations and other institutions as related to the Company's products and other subjects of agricultural interest.

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AGRICULTURAL NEWS LETTER

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The AGRICULTURAL NEWS LETTER serves as a medium of reporting new developments and new ideas in the field of agriculture, particularly as they are related to advancements through research. Material appearing herein may be reprinted in whole or in part, in the interest of advancing the general knowledge of new agricultural practices.

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FREEDOM -- TO WRITE OUR OWN TICKET

An Editorial

Depending on who we are and how we think about things, our yardstick for success may differ greatly. I well recall a theater manager in my hometown who used to brag 35 years ago that he had never in his life shaved himself; a boast which was a great puzzler to me at the time. Apparently that ability to buy a daily shave was a symbol of worldly attainment in his eyes.

It's human nature to develop our own sense of values. The freedom to establish these standards of accomplishment (within the bounds of good social conduct), and to "write our own ticket" in life to the extent of our abilities and opportunities, coupled with our individual differences, has resulted in some of us being farmers, some of us businessmen, some teachers, some preachers, some craftsmen, some salesmen.

Two Oklahoma farmers recently returned from a month's trip to Russia and reported that Soviet agriculture "is a monstrosity of wasted manpower -- 50 years behind this country." Yet, in the same interview, they told of a national champion tractor driver who is one of the highest paid men on a big communal farm in the USSR.

How is it possible that, in a tractor age and with much of the other modern equipment we use, Russian farmers still can be 50 years behind us in terms of crop yields and "real progress?"

Advanced technology, in our country, has given us all new tools to employ in any manner we felt would produce the most satisfying results in our business, in our home, or on our farm. As a result we have enthusiastically adjusted our sense of values to include those benefits which our modern machines and materials and chemicals could bring us. And they have brought us more food per acre, more tractors and cars, more leisure, and TV aerials on our roofs.

But would we have attained all these things if our individual sense of values had been limited by the dictates of a commissar -- if we had been deprived of the freedom to choose whether we would plant potatoes, or run cattle, or raise chickens? Would we have made the most of our new technological tools if there had been no indication that their use would bring us personal benefits? Or would we, too, be 50 years behind?

Soviet leaders use that word, "capitalist," as an epithet of disdain, but it's really the highest compliment they can pay us. For we're all "capitalists" in this country and our greatest "capital" is our freedom to set our own sense of values -- and the opportunity to live up to it.

* * * * * * IN THIS ISSUE * * * * * *

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Stretchy and lightweight, yet tough enough to resist abrasion and snagging, these new waders make use of the outstanding properties of neoprene synthetic rubber.

Measurement of the troll line paid out is registered accurately on the dial of this meter which can be clamped easily on any rod.

CHEMICAL MATERIALS SPARK NEW THINGS FOR FISHERMEN

Got some fishing trips planned this summer? If so, you may be interested in some of the new products for fishermen, made possible through the use of materials developed by the chemical industry.

Whether you favor stream, lake, bay, or surf casting, a new line of wading gear is bound to hold some appeal. Manufactured by an Ohio firm, they make use of neoprene synthetic rubber to achieve many advantages over former waders and wading shoes. The chest-high, lightweight, stretchy wader folds so small it can be stowed in a tackle box. The wading shoe folds flat for greater carrying convenience and gives the same sure-footedness as separate felts or chains. Light as it is, the material is tough enough to resist sand abrasion and underwater snags.

If you like to troll, there's a new meter made by a California company that clamps on any rod and tells you the length of line paid out. Molded of tough "Zytel" 101 nylon resin, it can also be used for sounding and for measuring any distance that the line can reach. When used on the rewind in surf fishing, cast distances can also be measured accurately. It's simply a matter of looping the line once around the capstan on the meter, then reading the length of line as it is registered on the dial.

Most promising for the fisherman who never has the "right bait" for the kind of fish that are running is a new line of aerosol spray products put out by a Chicago manufacturer. You just spray any of the five different "aromas" offered on your bait, depending on the sort of fish available -- or on what you want to catch if there's a choice. These fish-attracting scents are recommended for catching carp and panfish, catfish, trout, bass, or salt water fish, depending on the spray selected. The manufacturer says they contain essential and aromatic oils, "compounded of known fish-getting recipes of commercial and old time fishing guides that guarantee fish."

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TWO EXTRA PIGS PER LITTER

SAVED BY AIR CONDITIONING

A testimonial to the economics of air conditioning in a swine operation is reported by Joe Elliott, managing editor of "The Progressive Farmer," in a recent issue of that publication. Here's the story:

Neighbors kidded F. M. Stewart of Randolph County, Ga., a breeder of purebred Durocs, when he installed air conditioning in his farrowing house in 1953.

For some years, Mr. Stewart had experienced trouble in saving late summer and fall pigs and he figured that the survival of just one more pig per litter would more than pay the cost of air conditioning. So, in late 1953, two one-ton units were installed, one in each end of the farrowing house.

They weren't of much use that year, but in the fall of 1954 he saved an average of nine pigs per litter from 35 sows and gilts. In 1955, the average was eight and a half pigs per litter from 25 sows.

These records were "a good two pigs per litter better than I'd ever been able to do with fall pigs before," Mr. Stewart declared.

The reasons why air conditioning can account for these pig savings are pretty elementary -- just a matter of comfort. There is less crushing of pigs when sows are comfortable. They aren't so irritable. They don't get up and down so often to drink or root up fresh bedding.

Mr. Stewart's sows suckle better in the cooled houses. Pigs are noticeably larger at two weeks. He has no trouble from screwworms in pigs or sows when farrowing is in the enclosed house. Cost of electric current for operation runs about $1.00 per day in the hottest weather.

AMERICA'S ROAD AHEAD

by Crawford H. Greenewalt
President
E. I. du Pont de Nemours & Co.

Editor's Note: The following is adapted from remarks by Mr. Greenewalt before the 84th annual meeting of the Manufacturing Chemists' Association at White Sulphur Springs, West Virginia, in June.

There are few elements of economic life in our country that receive so much attention as the short-term fluctuations in business activity -- we seem even to have acquired a sort of national neurosis in this area. The pulse of the business system is examined hourly, and widespread attention is given to each diagnosis. If June carloadings are a few percentage points below those of the previous year or previous month, the fact is noted and appraised in much the same way as we might follow the progress of an ailing child. We are quick to find cause for rejoicing when the signs point upward, and just as quick to worry and fret when the indications are contrary.

It is an odd circumstance that when Mr. Curtice tells us that his industry is likely to sell 5,800,000 cars in 1956 the emphasis in the press is all upon the fact that this is down 15 or so per cent from 1955, and not on the equally undoubted fact that 1956 may well be the third highest year in the history of the industry.

The peaks and valleys which many see as the characteristic topography of capitalism have engaged the attention of its advocates and its foes for many years. More than a century ago the Reverend Malthus concluded that a certain amount of instability was probably unavoidable and expressed a most jaundiced view of the future. A generation later, Karl Marx was predicting even more frightening consequences from the swings of fortune which he, too, regarded as inevitable. At one time the theory was advanced that periodic upheavals in the economy were the results of sun spots and, as such, beyond the reach of either prevention or cure. Even today some economists seem to maintain that there is an inherent instability associated with capitalism which causes it to vibrate violently, no matter what we do to prevent it. . .

The fact is, of course, that there is nothing very remarkable in the ups and downs of economic activity, for there are few human adventures in which we are not obliged to accept a certain amount of lean along with the fat. I doubt very much whether any creative activity could be carried on with predictable results and an even tenor of performance -- if it were so the quality of inspiration would long ago have lost its potency. I am inclined to think that any venture which tried too hard to

avoid all the low spots would never climb very high into the hills.

It seems to me that the economists, learned men that they may be, have invariably regarded the economic particles under examination as though they were subject to precisely predictable patterns. The truth is that the elements comprising our economy, being human, have motivations and volitions and drives all their own. They are, in short, simply a multiplicity of human decisions and are, thus, subject to many unrelated, perhaps irrational, influences.

Human behavior, in other words, can be predicted only to the extent that, in the end, it will prove unpredictable. People, for some reason, decline to follow logical patterns and resist being marshalled into the neat, mathematical formulae devised for them. Our behavior with respect to the economic problems of any given day depends upon millions of personal decisions -- in the board rooms of our industries and in the living rooms of our citizens. They are decisions which may involve the commitment of millions of dollars in the construction of a new plant, or of a few dollars for the purchase of a new dress, and the difference between the two is largely one of scale. . .

It may be noted that in Karl Marx' time there was no such diffusion of judgment as marks our economy today. The average citizen had little to say as to the disposition of his income, for he could be certain that all he earned would go for the simple necessities required to maintain life -- indeed Marx' theory of prices was based precisely on this assumption, for he reckoned the value of any commodity on its labor cost at subsistence levels.

Today our problem is not only different but much more complex. The average American of our century, with half or more of his income available for things once regarded as luxuries, exercises a far more potent effect upon our national prosperity. Whether he spends his money or holds it for a rainy day is often dependent upon the economic weather reports to which he is exposed and whether he interprets them as fair and warmer or reads into them signs of a personal economic drought. Whatever the decision our economy will be affected one way or the other. . .

There is no denying the spectacular upsurge of the American economy over a very long period of time. Many have speculated as to the reasons for our dynamic advance. Some have pointed to the factor of critical size with the feeling that, had our continent been a little larger or a little smaller, progress would have been impeded. Others have pointed to our material resources or to the strength and vigor of our people. I am not too impressed with these notions -- many peoples have been strong and vigorous; many have had substantial resources; many have operated with a land mass roughly comparable to our own. Nor are genius and inventiveness unique to America. Our single great monopoly, if we may use so loose a term in so precise a sense, is the atmosphere of individual freedom and incentive which gives

full rein to human ingenuity. Here is monopoly in truth, unmatched elsewhere on earth. . .

Our experiment in government has succeeded beyond the wildest dreams of its early proponents. If we should need proof of a self-evident fact, we need only to reflect that we have weathered in our brief history as a nation panics and depressions, internal strife, and external pressures of a severity sufficient to undermine virtually every government on earth save our own. .

It is sometimes hard for us to appreciate the speed and the staggering significance of this change. For thousands of years the principal source and wellspring of all wealth was the land. Wealth was measured in terms of land units and the landlord was not only a familiar figure but a political force. In contrast, the more potent producers of our national wealth today operate almost independently of the land, for factories require little in the way of acreage or fertility.

The change has been a rapid one. In the decade following 1870, over 20 per cent of our national income came from agriculture and only 14 per cent from manufacturing. Today the respective proportions are something like seven per cent from the land and 35 per cent from our factories.

The point is that our system has been sufficiently flexible to accommodate this shift of direction, whereas in most nations the change, if accomplished at all, has brought social and political upheaval. . .

Pioneering has turned from the land to the far more challenging exploration of the physical sciences. The frontier which confronted Daniel Boone when he crossed these very mountains a century and a half ago seemed limitless. We can now see that the physical frontier of 1800, great as were its potentialities, was but a patch of woods compared to those which today spread without limit over the agenda of our research laboratories.

Yet we must remember that pioneering in the laboratory entails the same kind of risks, the same kind of disappointments, the same kind of frustrations as those faced by Boone and his party at the Cumberland Gap. It is slow and often fruitless plodding and, like the frontiersman, it seems that it must allow for failures and mistakes as well as for triumphs and discoveries. The conquest of the wilderness of science calls for the same faith, patience, and incentive as that reflected in our proudest moments of history.

I am sure the pioneer faced the peaks and valleys in an emotional as well as a geographical sense. I am sure that, on Boone's trek to Kentucky, there were days when he made less headway than he had the previous day, or indeed, when he was required to give up the hard-won position he had previously gained. There were certainly days when the wagon trains bogged down in the quicksand, when the day's march was interrupted or even thrown

into retreat, or when the hazards ahead seemed more than human courage might endure.

But courage prevailed, on the frontier of the forest just as it must in the boundless horizon of our new quest. We will have our disappointments and our setbacks I have no doubt. The economic road on which we travel will have its own quicksands and its own problems.

But let us make no mistake about it -- our destiny lies ahead. Which way the route will lead or what precisely lies over the hill we cannot say, anymore so than Boone and his compatriots could say at the outset of their journey. But they were sure, and we are sure, that the way lies forward, that great progress will be made, and the shape of our achievements, when they are reckoned up a century hence, would astonish us if we could live to see them. . .

If we are wise, we will set our sights high. We will focus on the objective which lies ahead - the green and fruitful plateau, not the stony ground and the patches of hard going we must cross to reach it. There is no virtue to stagnation, nor is there safety or security to be found in standing still. I think, if we are to have the esteem and regard of succeeding generations, it would behoove us to place our bets on the side of optimism. Most of our country's progress has come through a spirit of boundless confidence and optimistic disregard of the consequences of failure.

There is hardly a successful venture in our history, industrial or national, against which excellent arguments, highly logical arguments, could not have been marshalled at the outset. Undoubtedly, sound reasons were advanced as to why the transcontinental railroad should not be built, or why the settlements beyond the Ohio should never have been attempted. I can cite from my own experience that there were extremely plausible pleadings advanced to the effect that the Du Pont Company should not enter the field of dyestuffs, or the field of fundamental research, or the field of synthetic textile manufacture.

Fortunately, it was the optimist that prevailed. Much of our progress, it must be said, has come about because dreams have triumphed over cautious reality; because the poetry has proved more persuasive than the prose.

I am inclined to think that such venturesome victories, with the covey in the bush proving more attractive than the assured bird-in-hand, typify at this point the history of America. I am quite certain that they typify, in a most exciting and hopeful way, the future of America.

# # # # #

TRIBUTE TO AGRICULTURAL TECHNOLOGY -- "We could not have the cars, the steel, the electric power, the ships, the coal, the oil, the houses, the radios, the bathtubs, the running water, the clothing, and the recreation we now possess if one half, or even one third, of our working force were engaged in agriculture -- instead of only one ninth." -- Ezra Taft Benson

RUST CONTROL IN DURAM WHEAT

PROMISING WITH NABAM SPRAYS

Trials by growers of durum wheat and investigations at state colleges in the durum areas have shown promising control of rust on this important wheat through the use of "Parzate" liquid nabam fungicide.

On the basis of this work, directions on the use of "Parzate" liquid for control of this disease have been registered by the Du Pont Company with the U. S. Department of Agriculture. A residue tolerance of one part per million for the chemical in wheat has been established by the Food and Drug Administration.

The virulent strain of rust which has been prevalent in durum wheat areas has cut North Dakota's crop to one-sixth of average, and has generally made it impossible to grow even a fair crop. Yields in North Dakota last year averaged four bushels to the acre compared with a 14-bushel average for the previous 10 years.

Since plant breeders have not yet been successful in breeding durum wheat to resist this strain of rust, chemical control is a welcome alternative.

In 1955, "Parzate" was evaluated on five North Dakota farms -- two fields belonging to Clyde Barks of Egeland; Paul Abrahamson's farm in Rolla; on five acres belonging to Ole Ericksmeon in Leeds; on Melvin Johnson's farm in Sheron; and in a 10-acre field belonging to Ed Dornacker in Mayville.

Yield increases on these farms ranged from three to 17 bushels per acre in treated wheat compared with untreated where rust was moderately severe. Perhaps more important than the yield increases, the crop was saved, test weight on treated wheat was normal, treated wheat has excellent milling quality, and germination was not affected by treatment.

"Parzate" nabam fungicide was used at the rate of two quarts per 100 gallons of spray, in combination with zinc sulfate. The chemical mixture was applied at the rate of 20 to 25 gallons per acre, in a schedule of two to four treatments, as required by the severity of the disease. First application was made when rust began to spread through the field (often at early heading time) and succeeding applications were made at intervals of a week to 10 days.

"Parzate" nabam fungicide, when properly mixed, has the same fungicidal effect as "Parzate" zineb. Both have been used for controlling potato blight in the Red River Valley for nearly a decade.

PREVENTING INTERNAL PARASITES IN CATTLE

Seventeen States Now Recommend Control Measures

The damage done by inconspicuous internal parasite infections in cattle is now recognized to such an extent that at least 17 states are on record with recommendations for preventive control. Research studies and observations in commercial herds indicate that parasitism is conducting virtually a nation-wide raid on the pocketbooks of beef raisers and dairymen. Three principles are the basis for state parasite control recommendations in all geographic areas of the United States, even those where winter weather was once thought to break the cycle of parasitism.

These three methods are:

1. Therapeutic treatment of animals, using phenothiazine in spring and fall.

2. Low-level feeding of phenothiazine to prevent acute build-up of parasites.

3. Herd sanitation and pasture management to prevent intake of parasite larvae.

The states which have actually published recommendations include Arizona, Arkansas, California, Delaware, Florida, Illinois, Iowa, Louisiana, North Dakota, Ohio, Oregon, Pennsylvania, Utah, Vermont, Virginia, West Virginia, and Wisconsin.

Others, including Oklahoma, Texas, and Mississippi, have published results of one or more experiments, and there is evidence that parasitism is also a problem in Alabama, Kansas, Wyoming, Michigan, North Carolina, Georgia, and New York.

There is general agreement among state recommendations on the use of phenothiazine in a preventive program of low-level continuous feeding as well as in therapeutic treatments.

Therapeutic Treatment: Therapeutic treatment is recommended not only for acutely parasitized animals, but also as a routine preventive measure in spring and fall. Therapeutic dosages of phenothiazine can be administered in feed, as a drench, or in bolus form. A therapeutic dosage ranges from one to two ounces of the powder, depending on the age of the animal. Smaller dosages are recommended for animals that are obviously in poor condition. In severe infections, a second treatment may be administered within two to three weeks after the first.

Low-Level Continuous Feeding: Since phenothiazine itself is not readily taken by cattle, it is usually fed in a salt or salt-and-mineral mix, or in feed. The desirable amount is about two grams per head per day.

A mixture of one part phenothiazine to 10 parts salt can be fed as a free-choice supplement. Or a phenothiazine-mineral mixture can be made up with one part phenothiazine to

nine parts general mineral mixture. Another effective mixture contains three parts limestone, three parts bone meal, three parts salt, and one part phenothiazine.

Phenothiazine-feed mixtures have been made with cottonseed meal, combinations of cottonseed and alfalfa leaf meals, ground snapped corn, molasses base feed fed alone or mixed with citrus pulp, and with regular mixed dairy feeds. A cottonseed meal and salt mixture with phenothiazine has also been satisfactory where four pounds of cottonseed meal and one pound of salt were supplied for each five grams of phenothiazine.

Low-level feeding should be combined with periodic therapeutic dosage. Cattle should ordinarily be treated routinely in the spring, immediately before going on pasture. Severely infected animals should be treated again within two or three weeks. Another therapeutic treatment should be administered in the fall.

The Wisconsin Extension Service states that the basis for successful prevention and control of parasitic infection is sanitation employed in much the same way as the procedures followed in the production of Grade A milk. It is also pointed out, however, that satisfactory control cannot be obtained under practical farm conditions without resorting to treatment.

In pointing out the threat of parasitism in Iowa cattle, Dr. John B. Herrick, extension veterinarian at Iowa State College, writes "Now, contrary to popular belief, we know that cold winters do not prevent worm infection." The serious problem, he says, is not gross parasitism in which there are evidences of clinical symptoms and in many cases death, but in many instances light infections that put a drag on the productivity of cattle. Light infections are difficult to recognize, the only sure diagnosis being microscopic examination of the manure for worm eggs.

Dr. C. C. Hastings, Illinois veterinarian, has stated that internal parasites of cattle present a growing and major problem to the cattle industry of the Corn Belt. Fecal examination reveals nearly 100 per cent infestation in many herds. Many of these infestations are mild, especially in mature cattle. However, breeding animals serve as constant carriers to infest calves. Many young cows are retarded as a result, and their calves carry a heavy infestation of internal parasites. It is surprising how worming will cause the improvement of many slow-gaining feedlot cattle.

When cattle and sheep share the same pasture, says Dr. Hastings, the problem is more acute. Also, permanent pastures cause more trouble than temporary pastures.

The University of Illinois says: "Proper management and sanitation are also important, since these cut down exposure not only to parasitic worms but also to many diseases. Pastures should not be overstocked, and should be rotated frequently. Poorly drained pasture should be avoided. Low, swampy areas should be drained or fenced off. Animals should be fed in drylot if feasible. They should be fed from troughs and racks to pre-

vent contamination of feed with manure, and should be provided with clean drinking water. Manure should be removed from the barn often, and composted or spread on ground where cattle do not graze. Clean, disinfected quarters or clean, non-infested pastures should be provided for the birth of calves. The young animals should be separated from the adults as early as possible, since the adults are a source of infestation for them. An ample, well-balanced ration should be fed, and adequate minerals should be supplied."

In Oklahoma, winter performance of 34 Oklahoma A & M steers receiving phenothiazine was 50 per cent better than that of a control group of 35 steers not receiving the drug. In this test, worm control resulted in an average weight gain of 104 pounds per head for the treated group over the 154-day feeding period, whereas the lightly infected controls gained only 69 pounds per head in the same period--a difference of 35 pounds.

In Florida, authorities believe the abundance of moisture, sunshine, vegetation, and sand or muck soil presents a favorable environment for the development of parasites. The parasite problem is aggravated by extensive movements of cattle by air, rail, and truck. Furthermore, the numerous sales yards, which handle large numbers of transit cattle, spread parasites from one region to another.

The California Extension Service says management of irrigated pastures to control internal parasites is the same management that produces the greatest amount of high-quality forage.

Losses to stomach worms, estimated to run into several million dollars annually, can be especially serious on irrigated pastures because such pastures provide moist conditions and even temperatures at the base of plants where parasites thrive. They protect immature parasites from the drying effect of direct sunlight. Furthermore, the parasite population is likely to be high on irrigated pastures because these pastures carry more animals per acre than do non-irrigated lands. Since infective larvae live near the ground level, one of the best methods of protecting cattle is to avoid over-grazing. Rotation, which is good for the pasture, is also another preventive practice because many larvae will die when deprived of animal hosts.

Other states where irrigated pastures are common agree with California. Dr. Paul Allen, Oregon State College veterinarian, reports that the increase in use of irrigated pastures with accompanying intensified grazing has been instrumental in increasing the parasite problem in Oregon. As evidence that these losses are unnecessary, he cites the case of heavily infected yearling beef calves which tripled their rate of gain after treatment with phenothiazine.

In Arizona, Dr. William J. Pistor of the Department of Animal Pathology at the University of Arizona, reports that stom-

ach and intestinal worms have recently spread to cattle on open ranges as well as commonly occurring on irrigated pastures and feedlots.

A brief survey in Utah showed a serious parasite problem in practically every instance where an examination was made. Dr. Wayne Binns, chairman of the Veterinary Science Department at Utah State Agricultural College, in reporting this survey goes on to predict that the problem is going to get more serious because of the increase in herds and the trend toward permanent pasture and feedlots. The problem has reached such proportions, says Dr. Binns, that the "hidden bandits" consume much of the individual livestockman's profits without his knowing it.

In North Dakota, the responsibility for worm parasites which have appeared within the past decade has been laid to a highly efficient transportation system which enables internal parasites to be moved over great distances with their hosts. Nutritional advances have made it possible to raise more units of livestock per acre, and more parasites per animal, which in turn contaminate the pasture to higher and higher intensity.

In Texas, favorable reports on controlling gastrointestinal worm parasites by administering low-level phenothiazine to cattle are cited in a progress report on efforts to develop a satisfactory and economical mineral mix containing phenothiazine for cattle in the humid Gulf Coast area.

Editor's Note: A bibliography of current state references to internal parasite control in cattle will be sent on request.

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NEW "ARASAN" HAS HIGHER CONCENTRATION OF THIRAM

An improved thiram product for dry (dust) treatment of seed has been announced by the Du Pont Company. It is "Arasan" 75 thiram seed disinfectant and protectant, containing 75 per cent thiram, in comparison to 50 per cent thiram in "Arasan", which it replaces. The increased thiram content makes it possible to provide greater protection for certain seeds with less total dust applied. In addition to the increased concentration, the new product is a wettable powder which facilitates its use in slurry or sprays for certain specialized applications.

For example, it can be used for either dust or dip treatment of gladiolus bulbs and sweet potato sprouts, and it is especially suitable for use in slurry treatment of onion for the control of seed rot or in pelleting seed for the control of smut in onions grown for bulb production.

SPORE TRAP HELPING APPLE GROWERS TIME SCAB SPRAYS

An effective "watchdog" for orchardists is cutting the cost of scab control for Connecticut apple growers by reducing the number of spray applications and timing them most effectively.

Called a Hirst spore trap, it records the discharge of disease spores from overwintering mycelia. The spores are taken from a known volume of air about 18 inches above their point of liberation and are caught on a wax-coated micro slide. Clockwork moves the slide past a narrow intake slit, so the exposed slide represents a chronological record of spore dispersal for 24 hours. A vertical fin keeps the trap headed into the wind.

Dr. Patrick M. Miller of the Connecticut Agricultural Experiment Station's department of plant pathology and botany is operating the spore trap at the experimental farm at Mt. Carmel. His findings are reported regularly to apple growers by radio and press, through William D. Tunis, extension fruit spray specialist.

Since a spray application missed at a critical time may mean added expense later in eradicating infection on leaves, growers frequently apply more sprays than necessary to control scab. The information supplied by the spore trap, alerting them to the critical period for scab protection, should eliminate wasting materials and labor in spraying at the wrong times.

Cooperating in this research on timing apple scab spore dispersal is Dr. Paul E. Waggoner, head of the Connecticut station's department of climatology. Last year, he used the spore trap effectively to help forecast conditions favorable to outbreak of tobacco blue mold. He says the instrument may also be used in learning more about botrytis rot in strawberries. The spore trap has been used in Connecticut and elsewhere as an aid in forecasting spread of potato late blight.

Micro slides in this spore trap record the discharge of apple scab spores. Data from the device is recorded by Dr. Patrick M. Miller of Connecticut Agricultural Experiment Station and relayed to orchardists by press and radio through the extension service. Through proper timing of fungicide applications, the spore trap helps cut the cost of scab protection by reducing the number of sprays.

SOIL FACTORS RELATED TO HERBICIDAL ACTION OF THE SUBSTITUTED UREAS

by Dr. G. D. Hill, Research Division
Grasselli Chemicals Department
Du Pont Company

EDITOR'S NOTE: This article is based on a paper given by Dr. Hill at the Charter Meeting of the Weed Society of America. In his complete paper, he discussed soil factors affecting the main categories of chemical weed killers. This portion dealing with the substituted urea compounds is largely a summary of the work of a team of Du Pont researchers including D. W. Finnerty, J. W. McGahen, C. W. Bingeman, H. M. Baker, M. B. Weed, A. W. Welch, J. R. Haun, V. J. Fisher, B. L. Richards, and V. L. Turner.

The substituted ureas constitute a family of chemicals which include some versatile compounds with outstanding biological activity. The compounds in this family are effective herbicides at low rates of application on a wide range of species. Yet, when properly applied, some of these compounds can be used for selective control of weeds in cropland. The Du Pont Company has invested more than $3,000,000 in a research and development program in which over a thousand of these compounds have been prepared and studied.

To develop recommendations for using "Karmex" herbicides* for weed control in cropland, it has been necessary to study the relationships between growing plants (weeds, or crops, or both) and the soil. The soil is often regarded as little more than a binder which supports plants as they obtain water and nutrients. But in this framework of mineral matter there is continuous chemical and biological activity in a bath of air and water. Vigorous soil micro-organisms are continually multiplying and dying. Plant rootlets penetrate soil pores to the extent that the root hairs and soil particles are in intimate contact.

Both the effectiveness and the ultimate fate of herbicides in soil are influenced by a number of soil character-

*"Karmex" is the Du Pont Company's registered trademark for agricultural herbicide formulations of the substituted ureas. Four generic terms have been adopted by the Du Pont Company to identify the best-known substituted urea herbicidal compounds: monuron (3-(p-chlorophenyl)-1, 1-dimethylurea); diuron (3-3,4-dichlorophenyl)-1,1-dimethylurea); neburon (1-n-butly-3-(3,4-dichlorophenyl)-1-methylurea); fenuron (3-phenyl-1,1-dimethylurea). Monuron refers to the active ingredient in "Karmex" W herbicide; and diuron to the active ingredient in "Karmex" DW and "Karmex" DL herbicides. Agricultural uses of the other two compounds are being investigated.

istics, including: soil texture, soil structure, soil temperature, soil moisture, pH of the soil, humus content, chemical composition, and nature and extent of the microbiological population. Soil fertility also has an indirect effect because it governs the vigor and type of plant growth, and thus affects the response of plants to herbicides.

Considering these soil factors is only the beginning. The herbicide must be considered -- its physical, chemical and phytotoxic properties. Other factors to be taken into account include distribution and intensity of rainfall, and the growth characteristics of crops and weeds.

Whether an herbicide is used for pre-emergence or soil sterilization, its effectiveness is dependent on (1) movement, (2) activity, and (3) residual period in the soil. The success of a pre-emergence treatment depends mainly on the presence of a high concentration of herbicide in the upper 1/8 to 1/2 inch where most annual weeds germinate and a minimum concentration in the zone where crop seeds germinate. Conversely, soil sterilization is successful when the herbicide is distributed in the soil profile where the roots are active in absorption and when the herbicide remains in phytotoxic quantities for a sufficient period to allow absorption of a lethal dose. The residual period determines whether a compound is a temporary or relatively permanent soil sterilant.

When an herbicide is applied to the soil surface, the amount of herbicide that is absorbed by the roots of crop plants or weeds depends to a large extent on the amount of herbicide in solution in the soil water at the root zone. A compound applied to the surface of soil is ineffective initially, except on seedlings rooted in the surface layer. In general, only that portion of material which is in solution is moved downward by the action of rainfall. The amount of herbicide that is in solution in the root zone is influenced by the adsorptive capacity of the soil and the solubility of the compound. It follows that the rate of movement through the soil profile and the amount of compound available to the roots of plants is influenced by the degree to which a particular compound is adsorbed on a specific soil type. Strong adsorption results in slower downward movement with less material available in solution for absorption by the plants.

Several research workers have demonstrated that soil characteristics and rainfall distribution influence the herbicidal efficiency of "Karmex" monuron and diuron herbicides. Studies in Oregon* and in Du Pont laboratories have shown that differences in the herbicidal action of these compounds can be

*Sherburne, H. R. and Freed, V. H. "Adsorption of 3-(p-chlorophenyl)-1,1-dimethylurea as a Function of Soil Constituents." JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY 2 (18): 937-939, 1954.

explained partly by differences in solubility and by the degree to which each compound is adsorbed by various soil types.

In general, it was found that adsorption of monuron and diuron increases as the soil content of organic matter or clay increases. The importance of organic matter on adsorption was illustrated by removing most of the organic matter from one soil (one per cent clay and 97 per cent sand). When the organic matter, originally at a level of one per cent, was removed, adsorption of monuron was reduced by approximately 85 per cent.

In soil adsorption studies, larger amounts of diuron than monuron were adsorbed on all soils tested. Results of leaching studies indicated that the less soluble diuron (40 ppm at 25 C) moved more slowly than monuron (240 ppm at 25 C).

Results of field and laboratory studies have shown that monuron as a pre-emergence treatment provides an adequate safety margin to such economic crops as cotton, asparagus, sugar cane, and pineapple with satisfactory annual weed control on medium to high adsorbing soils under a wide range of rainfall conditions. Diuron, because of its low solubility and greater tendency to be adsorbed by soil, offers the desired safety margin on low adsorptive soils under medium to high rainfall conditions.

When considerably higher amounts, 40 to 60 pounds per acre, are applied for sterilant use to soils with a high adsorption capacity, the more soluble, less strongly adsorbed monuron moves downward and soil solution concentrations are maintained which control plant growth under most rainfall conditions. On medium and high adsorbing soils, with limited rainfall (20 inches or less), this compound penetrates the soil sufficiently to give control of annual weeds and shallow-rooted perennials. When conditions favor movement, i.e., low or medium adsorbing soils with high rainfall (30 inches or more), diuron is leached less readily from the soil surface and tends to maintain sterility longer than monuron under these conditions.

Results from numerous tests and commercial applications show that when monuron is applied at "sterilant" rates of 40 to 80 pounds per acre, a phytotoxic concentration may remain in the soil for 18 to 36 months, depending upon soil factors and the rainfall pattern. This extended residual activity at high rates has raised the question of whether pre-emergence rates of this and related substituted ureas would disappear from the soil at a rate which would permit annual re-treatments without hazard to succeeding crops.

Studies were made at Guelph, Ontario,* to determine the soil penetration and persistence of monuron applied at rates

*Birk, L. A. "Penetration of and Persistence in Soil of the Herbicide 3-(p-chlorophenyl)-1,1-dimethylurea (CMU)." CANADIAN JOURNAL OF AGRICULTURAL SCIENCE, 35: 377-387, 1955.

ranging from 1.6 pounds per acre up to 64 pounds per acre. Results of chemical analyses showed that 12 months after application, a total of 0.17 pounds was recovered from the 1.6 pounds per acre plots. With applications up to 32 pounds per acre, about 90 per cent of the monuron had disappeared in a year. The 64 pound plot showed 86 per cent disappearance in 12 months, and 94 per cent disappearance after two years.

In tests in Mississippi,* it was found that monuron and diuron, applied broadcast to cotton at two and four pounds per acre, result in sufficient residual toxicity to endanger oats planted for winter grazing. Rates of 1.0 to 1.5 pounds per acre were not hazardous to oats the following winter, if the herbicides were mixed thoroughly in the soil.

There has been intensive study of the disappearance of monuron and diuron from various soil types in the eastern half of the United States after repeated annual blanket applications of one to two pounds per acre. It was found that phytotoxic concentrations disappeared from the soil within four to eight months after application.

Laboratory tests on mechanisms relating to disappearance from soils show that leaching, chemical decomposition, and volatilization seem to play a minor role in disappearance. Photodecomposition (ultraviolet irradiation) of monuron has been demonstrated in the laboratory and possibly is important when the compound remains on the soil surface for long periods of time. The action of micro-organisms was concluded to be the primary factor in the disappearance of monuron and diuron on the basis of Warburg studies, rate of decomposition in sterilized vs. non-sterilized soil samples, and the rate of decomposition of radio-labeled monuron in soil. A soil bacterium of the Pseudomonas group which is capable of oxidizing monuron and using this compound as a sole source of carbon was isolated. In related studies it was found that bacteria such as Xanthomonas, Sarcina, and Bacillus, and fungi such as Penicillium and Aspergillus can use monuron as a sole source of carbon in agar medium.

Unlike 2,4-D and related compounds, the substituted ureas appear to be decomposed by the general soil microflora at a rather constant rate. Laboratory studies on repeated treatments of monuron and diuron to two soil types showed a fairly constant rate of decomposition with little tendency toward a rapid rate of degradation following repeated treatments.

It is encouraging to note that progress has been made in the last few years regarding the influence of soil factors on the performance of herbicides. There is a need for additional information on how the interaction of soil types with the chem-

*Hollingsworth, E. B. "Cotton Response to Two Substituted Ureas and CIPC and Their Persistence and Movement in Soil." PROCEEDINGS EIGHTH ANNUAL SOUTHERN WEED CONFERENCE, 294-304, 1955.

ical and physical properties of herbicides, and the intensity and distribution of rainfall influences the distribution, activity, and disappearance of herbicides in the soil profile.

Additional research on the action of temperature, moisture, and especially light, on the disappearance of herbicides from soil is a prerequisite to our increased understanding.

We have begun to appreciate the importance of the exchange complex in soils on the action of herbicides. A survey of the literature shows little existing information on the mechanism of adsorption and desorption of organic molecules on the colloidal complex of soils. We need to establish whether the clay content, organic matter content, total exchange capacity, anion exchange capacity, cation exchange capacity or total specific surface area is the best index of adsorption which can be used to predict the movement and activity of a particular herbicide. In many instances, a correlation of existing data on soil properties with existing data on herbicide performance will provide some of these answers.

The writer is in complete agreement with the prediction that in time farmers may send samples of soils to laboratories for analyses which would provide information for sound recommendations on how much, when, and how to apply an herbicide for maximum results.

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FARM SAFETY WITH CHEMICALS

Farmers are being urged by National Safety Council to adopt a four-point program to assure the safe use and handling of agricultural chemicals. Here are the points:

(1) Read the label on all chemical products, and then follow the instructions carefully. Heed all cautions and warnings.

(2) Keep chemical supplies away from children, irresponsible persons, and domestic animals -- both in use and in storage.

(3) Keep chemicals in their original, labeled containers. Never place an insecticide, fungicide, or other material of known toxicity in a jug, can, or container other than the original. Take no chances on its identity being mistaken.

(4) Dispose of empty containers promptly. Burn bags and fiber drums and stay out of the smoke. Wash non-returnable containers inside and out, crush or puncture them to prevent reuse -- then bury them, if possible. Seal returnable containers; wash the outsides thoroughly and return them promptly.

In case of an accident, a doctor should be called without delay.

TWENTIETH CENTURY GARDENING

by Howard A. Weibel, Manager
Garden Chemicals Section
E. I. du Pont de Nemours and Company, Inc.

Gardening is usually regarded as hard work. But push-button control of plant diseases and insects, and mechanical tools to take the backache and sweat out of gardening have come hand-in-hand with the building of millions of new homes and the modern trend toward more outdoor living. As American productivity has increased, people have more money for hobbies and more time to enjoy them.

Packaging of standard agricultural chemicals in garden-size containers was the first step in the development of chemicals for garden pest control. Next came the improvement of chemical formulations so gardeners could apply them with simple equipment, or kill both insects and diseases with one application. Finally has come research to develop products designed specifically for the gardener rather than adaptations of materials previously developed for agriculture.

Only the expansion of American home ownership with the resulting interest in gardening could have generated this third phase, for chemical research costs money. You can't cross-pollinate atoms and molecules. It takes trained chemists working in laboratories, toxicity studies, pilot-plant operations, field tests, formulation studies, packaging trials, and sometimes introductory marketing programs to see whether we really have something the consumer wants.

The importance of safeguarding public health is a paramount concern of the chemical industry in its search for new and better garden pesticides. The chemical industry must take for granted that one of the largest single cost items in the development of biological chemicals is the research necessary to assure that these chemicals can be marketed without introducing a hazard to health.

Four new fields of research that promise even better garden products in the future are: (1) the use of antibiotics to battle plant diseases; (2) systemic insecticides and fungicides which are absorbed in plant juices; (3) plant growth regulators which may make blossoms last longer on roses and extend the fruit-bearing season of trees and berry plants; (4) radioactive tracers resulting from atomic energy operations which will help research develop more effective pesticides.

While these investigations are by no means elementary, the practical applications of the results should help to achieve our long-range goal -- "Make Gardening Easier."

Editor's Note: The above is condensed from a speech by Mr. Weibel before the Men's Garden Club of Atlanta, Ga., recently. Copies of the full text are available on request.

EXPERIMENTERS' NOTATIONS

A Round-up of Data from Across the Nation

Cornell's department of agricultural economics has been studying the cost of growing and harvesting tomatoes. Records of 54 western New York growers who had at least 10 acres in the crop in 1954 showed an average cost of $270 per acre -- $166 in growing costs and $104 in harvest expenses. At $30 a ton, a production of nine tons per acre was required to break even. The records showed that the investment of a few additional dollars to protect the crop from diseases and insects, through a spraying or dusting program, was one of four factors that made the difference between a profit of $192 per acre (for those who used adequate fungicides and insecticides) as opposed to $45 per acre for the average of the growers studied.

* * * * * *

Speaking of tomatoes, Dr. R. W. Sampson of Purdue last year ran two different tests to check the effectiveness of various fungicides against anthracnose as it is evidenced by (1) defoliation in the field, and (2) infections developing after five weeks of storage. Six treatments at seven-day intervals proved markedly better than three treatments at 14-day intervals, both in keeping the leaves on and preventing infection. "Manzate" maneb fungicide was superior to others tested in both tests in retaining leaves. In three of four storage tests, "Manzate" applied on the seven-day program was superior to other fungicides in allowing least anthracnose after the lengthy storage period.

* * * * * *

Better stands and higher yields of soybeans are resulting from the planting of chemically protected seed, according to Henry Indyk, agronomist at the University of Delaware. This is especially true where cool, moist soil conditions cause the kind of damping-off which frequently kills young seedlings. He recommended thiram ("Arasan" seed disinfectant) as the material to use, at the rate of two ounces per bushel of seed.

* * * * * *

Used properly, some of the new substituted urea weed killers will control both annual broadleaf weeds and grasses in mint fields, without affecting either mint yields or oil quality, report W. R. Furtick and D. O. Chilcote, agronomists at Oregon State College. The materials specified are either "Karmex" W herbicide or "Karmex" DW herbicide, applied at the rate of two to three pounds per acre in at least 30 gallons of water. Choice between these two types depends on the type of soil in the field. "Karmex" DW is recommended on sandy soils, and "Karmex" W on heavier soils.

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